## 2.4.4.4 Test Procedures for Enhanced Squitter Reception Techniques

### 2.4.4.4.1 General

***Note:*** *This section defines the tests that are conducted to evaluate the performance of the improved preamble and enhanced squitter reception techniques of the equipment under test.*

The tests consist of injecting special waveforms to test the limits of preamble detection. The tests then proceed to inject a known Mode S extended squitter waveform at a nominal power level with a defined fruit overlap scenario to test the reception of the extended squitter data block. These tests are followed by a test scenario where Mode S fruit precedes a nominal Mode S extended squitter waveform to measure the re-triggering capability. Finally, a test is conducted to verify that the sliding window error correction technique is not used.

The success criteria for the tests require the monitoring of the Mode S extended squitter data content. This data must be available for test monitoring. Report level monitoring is not adequate.

In the following tests, the parameter **T** defines the number of trials that are to be executed. Unless otherwise indicated, **T** equals 1000.

### 2.4.4.4.2 Test Equipment Requirements

#### 2.4.4.4.2.1 Mode A/C Fruit Signal Source Requirements

Five RF sources **shall** be provided that are capable of generating Mode A/C 14-pulse replies. Each fruit source **shall** be capable of the following:

The waveform **shall** consist of framing pulses and an average of five data pulses. The data content of the fruit reply **shall** be pseudo randomly varied each time a fruit reply is generated. The data pulses **shall** be uniformly pseudo randomly distributed across the 12 data bit positions (the **X** pulse position **shall** not be used).

Each fruit source **shall** be able to generate Mode A/C replies at received power levels ranging from –80 to –58 dBm as required within plus or minus 1 dB.

The fruit sources should be able to sustain a repetition rate of at least 100 replies per second.

The signals for each of the fruit sources **shall** be non-coherent with any of the other fruit sources and the extended squitter signal source (2.4.4.4.2.3).

The leading edge of the P1 pulse of the Extended Squitter waveform **shall** be defined as t=0. The timing of the generation of the beginning of the F1 pulse of each fruit reply **shall** be controllable to be uniformly pseudo randomly distributed over the following interval:

-20 to +100 microseconds (Combined extended squitter preamble and data block with Mode A/C fruit test)

The pseudo random timing of the generation of fruit replies from each fruit source **shall** be independent of the timing of the other fruit sources.

**2.4.4.4.2.2 Mode S Fruit Signal Source Requirements**

One RF source **shall** be provided that is capable of generating a Mode S 112-bit transmission as follows:

The content of the 112-bit Mode S transmission **shall** consist of a valid DF code (16, 17, 18, 20, 21, or 24), an 83-bit field that is set pseudo randomly for each transmission, and a 24-bit PI field appropriate for the content of this transmission. If an extended squitter message type is used (DF = 17 or 18) the test equipment **shall** be capable of distinguishing the reception of the desired extended squitter from that of the Mode S fruit.

The Mode S fruit source should be able to sustain a squitter rate of at least 100 squitters per second.

The Mode S fruit source **shall** be capable of generating a signal power equal to 12 dB above the minimum MTL required for the equipment class being tested within plus or minus 1 dB with no more than 1 dB droop.

The signal for the Mode S fruit source **shall** be non-coherent with the extended squitter signal source (§2.4.4.4.2.1.3).

The leading edge of the P1 pulse of the Extended Squitter waveform **shall** be defined as t=0. The timing of the generation of the beginning of the P1 pulse of the Mode S fruit waveform **shall** be controllable to be uniformly pseudo randomly distributed over a defined interval or fixed as required by the test procedure. The following define the timing of the Mode S fruit source relative to the Extended Squitter waveform:

+8 to +90 microseconds (Data Block Tests with Mode S Fruit)

-112 to –6 microseconds (Re-triggering Tests with Varying Position Mode S Fruit)

-6 microseconds (Re-triggering Tests with Fixed Position Mode S Fruit)

### 2.4.4.4.2.3 Extended Squitter Signal Source Requirements

One RF source **shall** be provided that is capable of generating a 112-bit extended squitter transmissions with no more than 1 dB droop as follows:

The extended squitter power level **shall** be adjustable ranging from –21 dBm to –84 dBm within plus or minus 1 dB as required by the test procedures.

The extended squitter signal source should be able to sustain a squitter rate of at least 100 squitters per second.

Unless otherwise required, the contents of the extended squitter transmission **shall** consist of the five-bit DF field set to 17, an 83-bit field that is set pseudo randomly for each extended squitter transmission except for ME Field bits 1 to 5 (the Format Type Code) which may be set to a fixed value, and a 24-bit PI field appropriate for the content of this transmission.

*Note: The Four-Pulse Preamble Detection tests and the Preamble Validation Tests do not require pseudo-random message content, all other test procedures do.*

Provision **shall** be made to record the contents of each extended squitter transmission

*Note: This information is required to check for undetected errors.*

The extended squitter signal source **shall** have the capability to selectively control the width and/or position of individual preamble pulses with at least 25 nanosecond resolution. The extended squitter signal source **shall** also provide the capability of individually omitting preamble pulses or any of the first 5 data pulses from the transmission.

### 2.4.4.4.3 Four-Pulse Preamble Detection Tests

<u>Purpose/Introduction:</u>

These tests verify that the ADS-B reply processor correctly detects the presence of a valid ADS-B preamble whose pulse characteristics are within the allowable limits and rejects preambles having pulse spacing and position characteristics that are outside the allowable limits.

**Reference Input:**

Provide a method of supplying the UUT with:

Any Valid ADS-B Message having:

| | | |
|---|---|---|
| "DF" | = | 17 |
| "CA" | = | 0 |
| "AA" | = | Any discrete address |
| Message Rate | = | 50 Hz |
| Frequency | = | 1090 MHz |
| Power | = | -23 dBm (for the first preamble pulse level) |

**Input A:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.A: Input A: Preamble Pulse Characteristics**

| **Input A: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | +0.05 | — | — |
| 2 | 0.05 - 0.1 | 0.05 - 0.2 | -0.05 | +0.125 | +2 |
| 3 | 0.05 - 0.1 | 0.05 - 0.2 | +0.05 | +0.125 | +2 |
| 4 | 0.05 - 0.1 | 0.05 - 0.2 | -0.05 | +0.125 | 0 |

**Input B:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.B: Input B: Preamble Pulse Characteristics**

| **Input B: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | +0.05 | — | — |
| 2 | 0.05 - 0.1 | 0.05 - 0.2 | -0.05 | -0.125 | +2 |
| 3 | 0.05 - 0.1 | 0.05 - 0.2 | +0.05 | -0.125 | +2 |
| 4 | 0.05 - 0.1 | 0.05 - 0.2 | -0.05 | -0.125 | 0 |

**Input C:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.C:** **Input C: Preamble Pulse Characteristics**

| **Input C: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | -0.3 | — | — |
| 2 | 0.05 - 0.1 | 0.05 - 0.2 | -0.3 | 0 | 0 |
| 3 | 0.05 - 0.1 | 0.05 - 0.2 | -0.3 | 0 | 0 |
| 4 | 0.05 - 0.1 | 0.05 - 0.2 | -0.3 | 0 | 0 |

**Input D:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.D:** **Input D: Preamble Pulse Characteristics**

| **Input D: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | — | — |
| 2 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | +0.2 | 0 |
| 3 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | +0.2 | 0 |
| 4 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | +0.2 | 0 |

**Input E:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.E:** **Input E: Preamble Pulse Characteristics**

| **Input E: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | — | — |
| 2 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | -0.125 | 0 |
| 3 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | 0 | 0 |
| 4 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | +0.125 | 0 |

**Input F:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.F:** **Input F: Preamble Pulse Characteristics**

| **Input F: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | — | — |
| 2 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | 0 | 0 |
| 3 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | +0.125 | 0 |
| 4 | 0.05 - 0.1 | 0.05 - 0.2 | 0 | -0.125 | 0 |

**Input G:**

Same as the **Reference Input**, but having the following preamble pulse characteristics:

**Table 2.4.4.4.2.2.G:** **Input G: Preamble Pulse Characteristics**

| **Input G: Preamble Pulse Characteristics** | | | | | |
|---|---|---|---|---|---|
| **Pulse** | **Rise time** (µsec) | **Fall time** (µsec) | D **Width** (µsec) | D **Position** (µsec) | D **Amplitude** (dB) |
| 1 | 0.05 - 0.1 | 0.05 - 0.2 | +4.5 | — | — |
| 2 | Pulse Not Present | | | | |
| 3 | Pulse Not Present | | | | |
| 4 | Pulse Not Present | | | | |

Measurement Procedure:

The ADS-B receiver power levels specified in this procedure are relative to the loss at the RF message source end of the transmission line used to interface the RF message source to the UUT receiver input port. For each ADS-B equipage class, the specified power level is adjusted to compensate for the maximum line loss for which the UUT receiver has been designed. For example, if the line loss is 3 dB, then each of the RF message power levels specified in the test procedures is lowered by 3 dB.

Step 1: Preamble Pulse Characteristics set to the Extreme Limits of their Tolerance Range - Part 1

Apply **Input A** at the receiver input and verify that at least 90 percent of the ADS-B messages are correctly decoded.

Step 2: Preamble Pulse Characteristics set to the Extreme Limits of their Tolerance Range - Part 2

Repeat Step 1 with the signal power level at -65 dBm.

Step 3: Preamble Pulse Characteristics set to the Extreme Limits of their Tolerance Range - Part 3

Apply **Input B** at the receiver input and verify that at least 90 percent of the ADS-B messages are correctly decoded.

Step 4: Preamble Pulse Characteristics set to the Extreme Limits of their Tolerance Range - Part 4

Repeat Step 3 with the signal power level at -65 dBm.

Step 5: Preamble Pulse Widths set to Out-of-Tolerance Values - Part 1

Apply **Input C** at the receiver input and verify that no more than 10 percent of the ADS-B messages are correctly decoded.

Step 6: Preamble Pulse Widths set to Out-of-Tolerance Values - Part 2

Repeat Step 5 with the signal power level at -65 dBm.

Step 7: Preamble Pulse Positions set to Out-of-Tolerance Values - Part 1

Apply **Input D** at the receiver input and verify that no more than 10 percent of the ADS-B messages are correctly decoded.

Step 8: Preamble Pulse Positions set to Out-of-Tolerance Values - Part 2

Repeat Step 7 with the signal power level at -65 dBm.

Step 9: Preamble Pulse Positions set to Out-of-Tolerance Values - Part 3

Apply **Input E** at the receiver input and verify that no more than 10 percent of the ADS-B messages are correctly decoded.

Step 10: Preamble Pulse Positions set to Out-of-Tolerance Values - Part 4

Repeat Step 9 with the signal power level at -65 dBm.

Step 11: Preamble Pulse Positions set to Out-of-Tolerance Values - Part 5

Apply **Input F** at the receiver input and verify that no more than 10 percent of the ADS-B messages are correctly decoded.

Step 12: Preamble Pulse Positions set to Out-of-Tolerance Values - Part 6

Repeat Step 11 with the signal power level at -65 dBm.

Step 13: Preamble Single Pulse - Part 1

Apply **Input G** at the receiver input and verify that no more than 10 percent of the ADS-B messages are correctly decoded.

Step 14: Preamble Single Pulse - Part 2

Repeat Step 13 with the signal power level at -65 dBm.

**2.4.4.4.4 Preamble Validation Tests**

Purpose/Introduction:

These tests verify that the ADS-B reply processor correctly validates the ADS-B preamble. It is verified that when energy is contained in at least one chip of the first five data bits the preamble is accepted and the preamble is rejected if one or more of the first five data bits has no energy in either chip.

**Reference Input:**

Provide a method of supplying the UUT with:

Any Valid ADS-B Message having:

| | | |
|---|---|---|
| "DF" | = | 17 |
| "CA" | = | 0 |
| "AA" | = | Any discrete address |
| Message Rate | = | 50 Hz |
| Frequency | = | 1090 MHz |
| Power | = | -23 dBm |

The transmitted power in the first six data bits is controlled in such a way that a data bit can occur with no power being transmitted in either chip.

Measurement Procedure:

The ADS-B receiver power levels specified in this procedure are relative to the loss at the RF message source end of the transmission line used to interface the RF message source to the UUT receiver input port. For each ADS-B equipage class, the specified power level is adjusted to compensate for the maximum line loss for which the UUT receiver has been designed. For example, if the line loss is 3 dB, then each of the RF message power levels specified in the test procedures is lowered by 3 dB.

For this test to be valid the receiver must perform error correction.

Step 1: Preamble Validation – Missing First Data Bit - Part 1

Input the DF=17 messages with no energy in either chip of the first data bit into the receiver and verify that less than 10 percent of the ADS-B messages are correctly decoded.

Step 2: Preamble Validation – Missing First Data Bit - Part 2

Repeat Step 1 with the signal power level at -65 dBm.

Step 3: Preamble Validation – Missing Second Data Bit - Part 1

Input the DF=17 messages with no energy in either chip of the second data bit into the receiver and verify that less than 10 percent of the ADS-B messages are correctly decoded.

Step 4: Preamble Validation – Missing Second Data Bit - Part 2

Repeat Step 3 with the signal power level at -65 dBm.

Step 5: Preamble Validation – Missing Third Data Bit - Part 1

Input the DF=17 messages with no energy in either chip of the third data bit into the receiver and verify that less than 10 percent of the ADS-B messages are correctly decoded.

Step 6: Preamble Validation – Missing Third Data Bit - Part 2

Repeat Step 5 with the signal power level at -65 dBm.

Step 7: Preamble Validation – Missing Fourth Data Bit - Part 1

Input the DF=17 messages with no energy in either chip of the first data bit into the receiver and verify that less than 10 percent of the ADS-B messages are correctly decoded.

Step 8: Preamble Validation – Missing Fourth Data Bit - Part 2

Repeat Step 7 with the signal power level at -65 dBm.

Step 9: Preamble Validation – Missing Fifth Data Bit - Part 1

Input the DF=17 messages with no energy in either chip of the fifth data bit into the receiver and verify that less than 10 percent of the ADS-B messages are correctly decoded.

Step 10: Preamble Validation – Missing Fifth Data Bit - Part 2

Repeat Step 9 with the signal power level at -65 dBm.

Step 11: Preamble Validation – Missing Sixth Data Bit - Part 1

Input the DF=17 messages with no energy in either chip of the sixth data bit into the receiver and verify that greater than 90 percent of the ADS-B messages are correctly decoded.

Step 12: Preamble Validation – Missing Sixth Data Bit - Part 2

Repeat Step 11 with the signal power level at -65 dBm.

**2.4.4.4.5 Combined Preamble and Data Block Tests with Mode A/C Fruit**

Purpose/Introduction:

The following tests measure the performance of the equipment under test in decoding the extended squitter preamble and data block overlapped with Mode A/C fruit. The test series begins with monitoring the reception performance in the absence of interference to establish that the equipment under test is operating correctly.

Next, a series of tests are conducted with the number of Mode A/C fruit overlaps set to one to five respectively for A2 and A3 equipment class. For A1 equipment class, the tests are limited to a maximum of three Mode A/C fruit overlaps. For each test, the timing of the overlapping fruit is uniformly pseudo randomly distributed across the preamble and data block for seven different relative power levels. The fruit power levels will be set according to the test step being conducted and will remain constant while each of the seven extended squitter power levels are tested. **T** samples are taken at each power level. Squitters that are declared to be correctly received (i.e., received without errors or successfully error corrected) are compared to the known content of the extended squitter transmission. Any difference between the content of the decoded extended squitter and the known content of the injected squitter is recorded as an undetected error and that squitter reception is removed from the count of successfully received squitters.

The observed probability of correct squitter reception for each relative power level is computed. An average value of the performance across all power levels is computed and compared to the required performance to determine success or failure for the test.

Step 1: Verification of Operation of Equipment Under Test

Connect the extended squitter signal source and set the power level at the receiver input equal to the MTL limit required for the UUT equipment class:

–74 dBm for A1 equipment class or,

–79 dBm for A2 equipment class or,

–84 dBm for A3 equipment class.

Inject the extended squitter signal **T** times and record the extended squitters that are declared to be output as error free. Compare the decoded content of each extended squitter with the known content of the injected extended squitter. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions.

Calculate the measured probability of correct receptions and the number of undetected errors. The test is passed if the probability of correct receptions is at least 90% and there is no more than one undetected error event.

If this test is successful, proceed to Step 2. Otherwise, the test setup and equipment under test should be checked and Step 1 is repeated.

Step 2: Test with One Mode A/C Fruit Overlap

Set the extended squitter signal source as specified in Step 1.

Set the power level of one Mode A/C fruit source at the receiver input to the value corresponding to the UUT equipment class:

–62 dBm for A1 equipment class or,

–67 dBm for A2 equipment class or,

–72 dBm for A3 equipment class.

Activate the Mode A/C fruit source so that the fruit is pseudo randomly distributed across the extended squitter preamble and data block as specified in 2.4.4.4.2.1.

Inject the extended squitter waveform **T** times and record the receptions that are declared to be error free. Check for undetected errors and adjust as necessary the number of correctly received replies as specified in Step 1. Calculate the measured probability of correct reception and the number of undetected errors.

Repeat the above step six times while increasing the extended squitter power level by 4 dB with each iteration.

Calculate the average probability of reception and the total number of undetected errors across the seven power levels.

Step 3: Test with Two Mode A/C Fruit Overlaps

Repeat Step 2 with two fruit overlaps set to the following power levels and record the results:

-65 and –60 dBm for A1 equipment class or,

-69 and –65 dBm for A2 equipment class or,

-74 and –70 dBm for A3 equipment class.

Step 4: Test with Three Mode A/C Fruit Overlaps

Repeat Step 2 with three fruit overlaps set to the following power levels and record the results:

-66, -62 and –58 dBm for A1 equipment class or,

-71, -67 and –63 dBm for A2 equipment class or,

-76, -72 and –68 dBm for A3 equipment class.

Step 5: Test with Four Mode A/C Fruit Overlaps

Repeat Step 2 with four fruit overlaps set to the following power levels and record the results:

-73, -69, -65 and –61 dBm for A2 equipment class or,

-78, -74, -70 and –66 dBm for A3 equipment class.

Step 6: Test with Five Mode A/C Fruit Overlaps

Repeat Step 2 with five fruit overlaps set to the following power levels and record the results:

-75, -71, -67, -63 and –59 dBm for A2 equipment class or,

-80, -76, -72, -68 and –64 dBm for A3 equipment class.

Step 7: Determination of Success or Failure

Compare the results recorded above with the requirements in Table 2.4.4.4.5.1 or 2.4.4.4.5.1a.

**Table 2.4.4.4.2.4a: Success Criteria for Preamble and Data Block Tests with Mode A/C Fruit – A2 and A3 Equipment Class**

| **Number of Fruit** | **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|---|
| | | | | | |
| Minimum Probability | .99 | .97 | .93 | .88 | .82 |
| Max Undetected Errors | 1 | 1 | 1 | 1 | 1 |

**Table 2.4.4.4.2.4b: Success Criteria for Preamble and Data Block Tests with Mode A/C Fruit – A1 Equipment Class**

| **Number of Fruit** | **1** | **2** | **3** |
|---|---|---|---|
| | | | |
| Minimum Probability | .97 | .73 | .58 |
| Max Undetected Errors | 1 | 1 | 1 |

**2.4.4.4.6 Data Block Tests with Mode S Fruit**

Purpose/Introduction:

The following tests measure the performance of the equipment under test in decoding the extended squitter data content overlapped with Mode S fruit. The test series begins with monitoring the reception performance in the absence of interference to establish that the equipment under test is operating correctly.

Next, a test is conducted with a single Mode S fruit overlap. For this test, the timing of the overlapping fruit is uniformly pseudo randomly distributed across the data block for four different relative power levels. **T** samples are taken at each power level. Squitters that are declared to be correctly received (i.e., received without errors or successfully error corrected) are compared to the known content of the extended squitter transmission. Any difference between the content of the decoded extended squitter and the known content of the injected squitter is recorded as an undetected error and that squitter reception is removed from the count of successfully received squitters.

Finally, the observed probability of correct squitter reception for each relative power level is computed.

Step 1: Verification of Operation of Equipment Under Test

Connect the extended squitter signal source. Set and verify that the power level at the receiver input is equal to the MTL limit required for the UUT equipment class plus 12 dB:

–62 dBm for A1 equipment class or,

–67 dBm for A2 equipment class or,

–72 dBm for A3 equipment class.

Inject the signal **T** times and record the extended squitters that are declared to be output as error free. Compare the decoded content of each extended squitter with the known content of the injected extended squitter. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions.

Calculate the measured probability of correct receptions and the number of undetected errors. The test is passed if the probability of correct receptions is at least 95% and there is no more than one undetected error event.

If this test is successful, proceed to Step 2. Otherwise, the test setup and equipment under test should be checked and Step 1 is repeated.

Step 2: Test with One Mode S Fruit Overlap

Set the extended squitter signal source as specified in Step 1.

Activate the Mode S fruit source so that the Mode S fruit is pseudo randomly distributed across the data extended squitter data block as specified in 2.4.4.4.2.2.

Set the extended squitter power to 0 dB relative to the Mode S fruit signal level.

Inject the extended squitter waveform **T** times and record the receptions that are declared to be error free. Check for undetected errors and adjust as necessary the number of correctly received replies as specified in Step 1. Calculate the measured probability of correct reception and the number of undetected errors.

Repeat the above step for relative powers of signal to interference (S/I) of +4, +8, and + 12 dB.

Calculate the probability of correct reception and the number of undetected errors for each of the four power levels.

Step 3: Determination of Success or Failure

Compare the results recorded above with the requirements in Table 2.4.4.4.6.1.

**Table 2.4.4.4.6.1: Success Criteria for Data Block Tests with Mode S Fruit**

| **Relative Power, (S/I) dB** | **0** | | **+4** | | **+8** | | **+12** | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| Equipment Class | A1 | A2, A3 | A1 | A2, A3 | A1 | A2, A3 | A1 | A2, A3 |
| Minimum Probability | 0 | .01 | .22 | .5 | .87 | 1 | 1 | 1 |
| Max Undetected Errors | 1 | | 1 | | 1 | | 1 | |

### 2.4.4.4.7 Re-triggering Performance

Purpose/Introduction:

The following tests measure the capability of the equipment under test to detect extended squitters that are preceded by lower level Mode S fruit. The test series begins with monitoring the reception performance in the absence of interference to establish that the equipment under test is operating correctly.

Next, a test is conducted with a single Mode S fruit overlap with a varying position. For this test, the timing of the overlapping fruit is uniformly pseudo randomly distributed across the time interval beginning at – 112 microseconds and ending at – 6 microseconds relative to the leading edge of the P1 preamble pulse of the extended squitter.

Finally, a test is conducted with a single Mode S fruit overlap with a fixed position. For this test, the timing of the overlapping fruit is fixed at – 6 microseconds relative to the leading edge of the P1 preamble pulse of the extended squitter.

The re-triggering performance tests are conducted at three different relative power levels. **T** samples are taken at each power level. Squitters that are declared to be correctly received (i.e., received without errors or successfully error corrected) are compared to the known content of the extended squitter transmission. Any difference between the content of the decoded extended squitter and the known content of the injected squitter is recorded as an undetected error and that squitter reception is removed from the count of successfully received squitters. The observed probability of correct squitter reception for each relative power level is computed.

Step 1: Verification of Operation of Equipment Under Test

Connect the extended squitter signal source. Set and verify that the power level at the receiver input is equal to the MTL limit required for the UUT equipment class plus 12 dB:

–62 dBm for A1 equipment class or,

–67 dBm for A2 equipment class or,

–72 dBm for A3 equipment class.

Inject the signal **T** times and record the extended squitters that are declared to be output as error free. Compare the decoded content of each extended squitter with the known content of the injected extended squitter. Any differences that are detected are recorded as an undetected error and that squitter reception is deleted from the count of error free receptions.

Calculate the measured probability of correct receptions and the number of undetected errors. The test is passed if the probability of correct receptions is at least 95% and there is no more than one undetected error event.

If this test is successful, proceed to Step 2. Otherwise, the test setup and equipment under test should be checked and Step 1 is repeated.

Step 2: Re-triggering Test with Varying Position Mode S Fruit

Connect the Mode S Fruit signal source. Set and verify that the power level at the receiver input is equal to the MTL limit required for the UUT equipment class plus 12 dB:

–62 dBm for A1 equipment class or,

–67 dBm for A2 equipment class or,

–72 dBm for A3 equipment class.

Set the extended squitter power to +4 dB relative to the Mode S fruit signal level.

Activate the Mode S fruit source so that the 112-bit Mode S fruit signal is uniformly randomly distributed across the time interval beginning at – 112 microseconds and ending at – 6 microseconds relative to the leading edge of the P1 preamble pulse of the extended squitter. The timing indicated is the spacing from the leading edge of the P1 pulse of the Mode S fruit to the leading edge of the P1 pulse of the extended squitter.

Inject the extended squitter waveform **T** times and record the receptions that are declared to be error free. Check for undetected errors and adjust as necessary the number of correctly received replies as specified in Step 1. Calculate the measured probability of correct reception and the number of undetected errors.

Repeat the above step for relative powers of signal to interference (S/I) of +8, and + 12 dB.

Calculate the probability of correct reception and the number of undetected errors for each of the three power levels.

Compare the results recorded above with the requirements in Table 2.4.4.4.7.1.

**<u>Table 2.4.4.4.7.1:</u> Success Criteria for Re-triggering Test with Varying Position Mode S Fruit**

| **Relative Power, (S/I) dB** | **+4** | | **+8** | | **+12** | |
|---|---|---|---|---|---|---|
| | | | | | | |
| Equipment Class | A1 | A2, A3 | A1 | A2, A3 | A1 | A2, A3 |
| Minimum Probability | .11 | .13 | .72 | .93 | .95 | .99 |
| Max Undetected Errors | 1 | | 1 | | 1 | |

<u>Step 3:</u> Re-triggering <u>Test with Fixed Position Mode S Fruit</u>

Connect the Mode S Fruit signal source. Set and verify that the power level at the receiver input is equal to the MTL limit required for the UUT equipment class plus 12 dB:

–62 dBm for A1 equipment class or,

–67 dBm for A2 equipment class or,

–72 dBm for A3 equipment class.

Set the extended squitter power to +4 dB relative to the Mode S fruit signal level.

Activate the Mode S fruit source so that the 112-bit Mode S fruit signal has a fixed position at – 6 microseconds relative to the leading edge of the P1 preamble pulse of the extended squitter. The 6-microsecond spacing is the time from the leading edge of the P1 pulse of the Mode S fruit to the leading edge of the P1 pulse of the extended squitter.

Inject the extended squitter waveform **T** times and record the receptions that are declared to be error free. Check for undetected errors and adjust as necessary the number of correctly received replies as specified in Step 1. Calculate the measured probability of correct reception and the number of undetected errors.

Repeat the above step for relative powers of signal to interference (S/I) of +8, and + 12 dB.

Calculate the probability of correct reception and the number of undetected errors for each of the three power levels.

Compare the results recorded above with the requirements in Table 2.4.4.4.7.2.

**<u>Table 2.4.4.4.7.2:</u> Success Criteria for Re-triggering Test with Fixed Position Mode S Fruit**

| **Relative Power, (S/I) dB** | **+4** | | **+8** | | **+12** | |
|---|---|---|---|---|---|---|
| | | | | | | |
| Equipment Class | A1 | A2, A3 | A1 | A2, A3 | A1 | A2, A3 |
| Minimum Probability | 0 | .31 | .45 | .95 | .89 | .99 |
| Max Undetected Errors | 1 | | 1 | | 1 | |

### 2.4.4.4.8 Test to Verify the Sliding Window Error Correction Is Not Used

***<u>TBD</u>***